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ABSTRACT

This study tested a learning productivity model for undergraduates at four-year colleges and universities using hierarchical linear modeling. Student level data were from 44,328 full-time enrolled undergraduates from 120 four-year colleges and universities who completed the College Student Experiences Questionnaire between 1990 and 1997. Institutional level data came from various sources. Institutional characteristics had effects on student engagement and gains from colleges and universities, and the institutional effects on gains were through effects on engagement, effects on gains, or effects on the conversion rates from effort to gains. The effects also varied depending on the types of gains students had from colleges and universities. The findings have implications for the conversations on collegiate quality and research on college impacts on students. Three appendixes contain instrument scale items and results from the analyses. (Contains 1 figure, 4 tables, and 37 references.) (Author/SLD)

A multilevel analysis on student learning in colleges and universities

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Student Learning in American Colleges and Universities: Unraveling the Effects of Institutional Characteristics

Abstract

This study tests a learning productivity model for undergraduates at four-year colleges and universities using hierarchical linear modeling. Student level data were from 44,238 full-time enrolled undergraduates from 120 four-year colleges and universities who completed the College Student Experiences Questionnaire between 1990 and 1997. Institutional level data came from various sources. Institutional characteristics had effects on student engagement and gains from colleges and universities, and the institutional effects on gains were through effects on engagement, effects on gains, or effects on the conversion rates from effort to gains. The effects also varied depending on the types of gains students had from colleges and universities. The findings have implications for the conversations on collegiate quality and research on college impacts on students.

Student Learning in American Colleges and Universities: Unraveling the Effects of Institutional Characteristics

Introduction

Student learning is one of the central functions of undergraduate education. Despite considerable evidence that college attendance is associated with numerous desirable short and long-terms effects (Astin, 1993b; Pascarella & Terenzini, 1991), various groups from inside and outside the academy continue to press for improvement in the quality of the baccalaureate experience (Educational Commission of the States, 1995; Kellogg Commission, 1997; Wingspread Group on Higher Education, 1993). Such expectations are appropriate, given that more students than ever are participating in higher education and the knowledge, skills, and competencies acquired during college are considered essential for the post-college success of individuals, preparation of an informed citizenry, and continued expansion of an information-based economy.

Unfortunately, there are few external incentives for institutions of higher education to improve undergraduate education. In part, this is because the conversation about "quality" tends to center on such things as institutional resources and reputations, variables that are only weakly linked to learning. They also overlook the key factors that can enhance student learning -- the investments that institutions make to engage students in proven instructional practices. The weight of the evidence in the higher education literature points to student engagement as the key factor in student learning and personal development (Astin, 1993b; Pascarella & Terenzini, 1991). That is, what matters most to learning is the quality of effort students expend on using the institution's resources and facilities, such as the amount of time they spend studying or using the library. Therefore, one of the key challenges for all colleges and universities is to arrange their resources for learning so that students spend more of their time on the activities that matter to their education. We need to learn more about this untapped dimension of collegiate quality including the characteristics of institutions that are more or less effective in promoting student learning.

The Carnegie Classification of Institutions of Higher Education (1994) was originally created to promote research on higher education issues and problems (Carnegie Foundation for the Advancement of Teaching, 1973) and is the most often used institutional characteristic in studies of the college student experience. The classification is primarily based on such variables as numbers and types of degree programs (including graduate and professional education), numbers of degrees granted, and research productivity. However, these measures are not strong predictors of many important outcomes of the undergraduate experience. The best predictor of what students gain from college (after controlling for student background characteristics) is student effort -- the extent to which students use institutional resources to educational advantage (Astin, 1984, 1993b; Kuh, 1999; Pace, 1984; Pascarella & Terenzini, 1991). The constellation of factors that represent student effort is not considered in the Carnegie classification. Even so, the institutional types popularized by the Carnegie classification system continue to be widely used in research and commentary on the undergraduate experience. For example, the Boyer Commission on Educating Undergraduates in the Research University (1998) and Sperber (2000) sharply criticized the sub-par quality of baccalaureate education at research universities. National college student databases such as The National Survey of Student Engagement, the College Student Experiences Questionnaire, and the Cooperative Institutional Research Program typically report findings using the Carnegie institutional types.

After reviewing the 1994 classification system, The Carnegie Foundation for the Advancement of Teaching is revising its schema to make it more flexible and comprehensive for both research and policy analysis purposes (2000). Following fairly modest changes released this fall, fundamental changes to the 1994 schema are promised by 2005, perhaps with the addition of some features that more clearly distinguish among institutions that emphasize undergraduate education.

Purpose

This study is based on the proposition that colleges and universities can promote student learning in multiple ways. To examine this proposition we will delineate and test a learning productivity model for colleges and universities. In the tradition of educational production function research (Bowles, 1970; Coleman, et al., 1966; Hanushek, 1979) and college impact studies (Astin, 1993a; Ethington, 1997; Pascarella & Terenzini, 1991), we intend to determine the contributions of a variety of institutional characteristics to a range of important undergraduate learning outcomes, including self-directed learning, analysis and synthesis skills, writing ability, team work, and so forth.

The main research question guiding the study is: what institutional characteristics contribute to undergraduate learning from colleges and universities at institutional level? Institutional learning productivity is defined in this study as the average amount of effort students expend in educationally purposeful activities (those empirically linked to desired outcomes of college), the average gains reported by students in 23 important areas of learning and personal development, and the conversion rate of student effort to student gains.

Perspectives

Studies on Educational Production Function

Research on learning productivity dates back to the publication of *Equality of Educational Opportunity*, more commonly known as the "Coleman Report" (Coleman, et al., 1966). In this study the researchers estimated an input-output model to determine the relationship between student achievement and inputs, which was defined as student and family characteristics and school resources. Subsequently, economists introduced the concept of educational production function to describe the relationships between observed student outcomes and inputs (Hanushek, 1979). The early educational production function model was typically estimated using multiple regressions, where the outcome variables were regressed on all input variables.

Although there are different views about the degree to which school inputs affect student performance (Butless, 1996), most economists and educational researchers acknowledge that student achievement is influenced by a set of factors including student characteristics and characteristics of the learning environment (broadly defined) in which learning occurs. Inputs refer to the personal qualities the student brings to college, such as ability, attitudes, aspirations, and socio-economic status. Outcomes refer to student "talents" to be developed, such as intellectual functioning and interpersonal competence. The environment refers to the array of student experiences during college including interactions with faculty members and peers as well as structural and perceptual features of the institution (Astin, 1993a, 1993b; Pace, 1990; Pascarella & Terenzini, 1991).

Two models are frequently used to explain undergraduate learning and personal development in college. In Astin's (1993a) Input-Environment-Output (I-E-O) model, student learning (outcomes) are presumed to be a function of the interactions of inputs and the environment which encompasses student perceptions and behavior as well as an institution's human, financial, and physical resources. In Pascarella's (1985) model student learning is presumed to be a function of the interaction of student background characteristics (inputs), institutional characteristics (size, affluence, student-faculty ratio), student interactions with agents of socialization (faculty, peers), student perceptions of the environment, and student quality of effort. The preferred methodological strategy is sequential multiple regression, where the input variables are treated as control variables and environment variables are the independent variables to be regressed on outcome variables.

The Learning Productivity Model

The conceptual approach used in this study splits the environment component of the Astin I-E-O model into two sets of variables, which makes it more consistent with the Pascarella model. One set of variables is "quality of effort" (Pace, 1984), which is defined as the frequency of student engagement in various educationally purposeful college activities that are empirically linked with desired outcomes of college. The other environment variable includes such measures as institutional type, selectivity, and student perceptions of the campus climate including (a) the degree to which the school emphasizes scholarship or critical analysis and (b) the quality of relations between students and faculty, students and administrators, and students and students. This approach allows us to better understand how learning is influenced by what students do, what institutions provide, and what students think about their institutions.

This learning productivity model proposes that institutions affect student learning in at least three ways as illustrated in Figure 1. First, a college or university school can arrange its intellectual resources and design policies and practices to engage students at higher average levels in educational purposeful activities. Examples of some of these successful approaches are learning communities, small classes for first-year students, capstone courses for seniors, and intrusive developmental advising. Second, student learning can be improved by increasing the conversion rate of student effort to gains. That is, at high performing institutions the yield of student effort in terms of gains may be greater compared with other colleges and universities. A third approach is to increase the average "net" amount that students gain from their educational experience, independent of their engagement in college activities or the effort to gain conversion rate. In Figure 1 this is illustrated as the gross effect of institutions on student gains from college which is a function of these three components: (a) the effects of institution-level effort, (b) the effects of the effort-gain conversion rate, and (c) the net effects on institutional average gain. If we can better understand the effects of these three sources of institutional contributions on student learning and coordinate their influence so they have complementary, positive effects on students, we may be able to increase learning productivity and improve the quality of undergraduate education.

(Insert Figure 1 About Here)

Methods

Data Source and Instrument

The sample is composed of 44,238 full-time enrolled undergraduates at 120 four-year colleges and universities who completed the third edition of the College Student Experiences Questionnaire (CSEQ) between 1990 and 1997. No transfer students are included in the sample. That is, all the students started college and attended only the institution at which they were enrolled when they filled out the CSEQ. Using only native, full-time students was done because the purpose of the study was to examine the impact of institutional characteristics on students. Including part-time and transfer students would have confounded the findings, making the results very difficult to interpret. The institutions included 20 research universities (RUs), 14 doctoral universities (DUs), 41 comprehensive colleges and universities (CCUs), 15 selective liberal arts colleges (SLAs), and 30 general liberal arts colleges (GLAs) (Carnegie Foundation for the Advancement of Teaching, 1994). Table 1 shows the background characteristics of the sample.

Women (61%) and first-year students (41%) were somewhat over-represented compared with the national profile of undergraduates attending four-year colleges and universities before 1998. Also, about half of the students (44%) were majoring in a pre-professional area.

(Insert Table 1 about here)

The College Student Experiences Questionnaire (CSEQ) is well suited to address the purposes of this study in that it is based on a simple but powerful premise related to student learning. That is, the more students put into using the resources and opportunities an institution provides for their learning and development, the more they benefit (Kuh, Vesper, Connolly, & Pace, 1997). Also, the CSEQ has excellent psychometric properties and high to moderate potential for assessing student behavior associated with college outcomes (Ewell & Jones, 1996). The items are well constructed and responding to the questionnaire requires that students reflect on what they are putting into and getting out of their college experience. As with all survey questionnaires, the CSEQ relies on self-reports from students. Examinations of the validity of self-reports (Baird, 1976; Lowman & Williams, 1987; Pace, 1984; Pike, 1989, 1995; Pohlman & Beggs, 1974; Turner & Martin, 1984) indicate that they are generally valid if they meet three conditions: (1) when the information requested is known to respondents, (2) if the questions are phrased clearly and unambiguously, and (3) if respondents think the questions merit a serious and thoughtful response (Pace, 1985). CSEQ items satisfy all these conditions. The distributions of responses on the Activities and Gains scales are approximately normal and the psychometric properties of the instrument indicate it is reliable (Kuh, Vesper, Connolly, & Pace, 1997). The Gains items ask students how much they think their college or university experience contributed to their own growth and development and Gain scores are generally consistent with other evidence, such as results from achievement tests (Pace, 1985; Pike, 1995). For example, Pike

(1995) found that student reports of their experiences using the CSEQ were positively correlated with relevant achievement test scores. In this sense the progress students report is a "value-added" judgment (Pace, 1990b).

Variable Specifications

Seven dependent variables were specified for this study. The first is EFFORTSUM, a measure of the quality of student effort. The second is GAINSUM, students' self-report of the progress they have made toward desirable outcomes of college. The original measurement of these variables is presented in Table 1. They are defined for this study as follows:

- EFFORTSUM (the sum of student responses to the 14 CSEQ quality of effort scales covering 128 items which ask students how often they engaged in certain college activities. Response options for the effort items are 1= "never," 2= "occasionally," 3= "often," and 4= "very often.").
- GAINSUM (the sum of student responses to the 23 CSEQ gains items which ask students how much their college or university experience contributed to their growth and development during college. Response options for the gains items are 1= "very little," 2= "some," 3= "quite a bit," and 4= "very much").
- Five measures of learning outcomes distilled from a factor analysis of the 23 Estimate of Gains items. They are Intellectual Skills, General Education, Personal/Social Development, Science/Technology, and Practical/Vocational Preparation (Kuh, et al, 1997). Pace (1990b) recommended using the Estimate of Gains factors when the number of respondents is large and the sample is from multiple institutions, as is the case in this study. The measures of the five gain factors were the sums of the response to the gain items clustered within each gain factor. The response options for the gains items are 1= "very little," 2= "some," 3= "quite a

bit," and 4= "very much." The gain items included in each gain factor are presented in Appendix A.

The student-level control variables are defined as follows:

- Sex (0=female, 1=male);
- Race or ethnicity was coded as a set of dummy variables: Asian Americans, African Americans, Latinos, Whites, and students from "other" backgrounds (American Indians and others), with Whites as the omitted reference group;
- SES (the sum of parent education where 1=neither parent a college graduate, 2=one parent a college graduate, and 3=both parents college graduates and the amount parents contribute to college costs where 1=none to 4=all or nearly all).
- Academic capital (the sum of grades where 5=A and 1=C, C- or lower and educational aspirations where 2=expect to pursue an advanced degree after college and 1=does not expect to pursue an advanced degree).
- Major fields (four major field clusters coded as dummy variables: humanities--arts, literature, history, philosophy, religion, foreign language; science and mathematics including computer science; social sciences--economics, political science, psychology, sociology; and professional/applied--agriculture, business, education, engineering, health-related fields such as nursing. Students who were undecided or indicated some "other" major were excluded from this analysis. Pre-professional was omitted as the reference group;
- Year in college (first-year, sophomore, junior, and senior, with first-year omitted as reference group);
- Hours per week devoted to attending and preparing for class (1=less than 20, 2=about 20, 3=about 30, 4=about 40, and 5=about 50 or more).

The institution-level variables are defined as follows:

- Institutional control (0=private, 1=public);
- Institutional selectivity (6=most competitive, 5=highly competitive, 4=very competitive, 3=competitive, 2=less competitive, and 1=not competitive from year 1996 *Barron's Profiles of American Colleges*).
- Institutional type (RU, DU, CCU, SLA, GLA with CCU omitted as reference group);
- Institutional environment measures: Eight environment scales that assess students' perceptions of aspects of the college environment were clustered into three institutional environment measures to reduce the risk of multi-colinearity among variables and reduce the dimensions of institutional environment measures (Kuh, et al., 1997) (Appendix A). They represent the degree to which students perceive their institution emphasizes scholarly and intellectual activities, vocational preparation or practical issues in courses, and students' perceptions of the quality of relations that exists among different groups (student-student, student-faculty, student-administration).

Statistical Model and Data Analysis

To test the learning productivity model, we used Hierarchical Linear Modeling (HLM) (Bryk & Raudenbush, 1992; Ethington, 1997, 2000), an approach especially well suited to examining questions that require data about student experiences and institutional characteristics. All student-level continuous variables were standardized as z-scores (M=0, SD=1), centered on the grand-mean of the sample of students. Institution-level continuous variables were also standardized as z-scores (M=0, SD=1), centered on the grand-mean of the sample of institutions. Because the variables are either dummy-coded categorical variables or z-scored continuous variables, the results are presented in the metric of student-level standard deviation units of

EFFORTSUM and GAINSUM (Lee & Smith, 1999).

The estimates of learning productivity were done in two steps. First, we estimated a two-level model on the effects of institutional characteristics on EFFORTSUM (engagement in educationally purposeful activities). In this model, institutional characteristics were assumed to have a direct effect on the average value of EFFORTSUM after controlling for individual student characteristics. The student-level model was estimated by:

(1) $EFFORTSUM_{ij} = \beta_{j0} + \beta_{j1}X_{ij1} + \beta_{j2}X_{ij2} + \ldots + \beta_{jp}X_{jjp} + \varepsilon_{ij}$ where i represented the ith student, j represented the jth institution, and p represented the pth student level covariate. X represents student characteristics such as gender, race or ethnicity, academic preparation, and so on, and the coefficients of X represent how student characteristics affect EFFORTSUM.

The institution-level model was estimated by:

(2) $\beta_{j0} = \gamma_{0k} + \gamma_{1k}Z_{j1} + \gamma_{2k}Z_{j2} + \ldots + \gamma_{qk}Z_{jq} + \nu_{jk}$ where j represented the jth institution and q represented the qth institutional level covariate. Z represents institutional characteristics such as institutional type, selectivity, environment, and so forth, and the coefficients of Z represent how institutional characteristics affect student effort.

The second step was estimating a two-level model in which the sum of student-reported gains (GAINSUM) was the dependent variable and EFFORTSUM was the independent variable. This step serves two purposes. First, it determines if there are differences between institutional characteristics in the conversion rates of EFFORTSUM to GAINSUM. Second, it allows us to determine if institutional characteristics have a net effect on GAINSUM after taking into account the difference in EFFORTSUM and the difference in the conversion rates of EFFORTSUM to GAINSUM. In this model, institutional characteristics were assumed to affect both the average values of GAINSUM and the EFFORTSUM to GAINSUM conversion rate (the slope of

EFFORTSUM) at the institutional level, when individual student characteristics are held constant.

The student-level model was calculated as:

(3) $GAINSUM_{ij} = \beta'_{j0} + \beta'_{j1} EFFORTSUM_{ij} + \beta'_{j2} X_{ij2} + ... + \beta'_{jp} X_{ijp} + \varepsilon'_{ij}$ where i, j, p, and X had the same representation as in equation (1). β' represents how student characteristics affect student GAINSUM.

The institution-level model was estimated by:

(4) $\beta'_{j0} = \gamma'_{0k} + \gamma'_{1k} Z_{j1} + \gamma'_{2k} Z_{j2} + ... + \gamma'_{qk} Z_{jq} + \nu'_{jk}$ and

(5) $\beta'_{j1} = \gamma''_{0k} + \gamma''_{1k} Z_{j1} + \gamma''_{2k} Z_{j2} + ... + \gamma''_{qk} Z_{jq} + \nu''_{jk}$, where j, q and Z had the same representations as in equation (2). γ' and γ'' represent how institutional characteristics affect institution-level average EFFORTSUM and the conversion rate of EFFORTSUM to GAINSUM.

In equation (2), institutions are assumed to have direct effects on EFFORTSUM. In equation (4), institutional characteristics are assumed to have a direct (net) effect on student gains (GAINSUM), after controlling for EFFORTSUM, and in equation (5), institutional characteristics are assumed to have a direct effect on EFFORTSUM-GAINSUM conversion rate. To paint a more complete picture of institutional effects on student GAINSUM from college, we also need to understand the gross effect of institutions on GAINSUM (Pascarella & Terenzini, 1991). The gross effect of institutions on student GAINSUM is defined as the combination of the direct effect of institutions on EFFORTSUM, the net effect of institutions on the EFFORTSUM-GAINSUM conversion rate, and the net effect of institutions on GAINSUM. We estimated the gross effect of institutions on GAINSUM by redoing the above analysis from equations (3) to (5) while excluding EFFORTSUM from the independent variables tested in the model (Pascarella &

Terenzini, 1991).

To examine how institutional type and environmental measures affected the five gain factors, the gain factors were introduced separately as dependent variables using the same analytical model as GAINSUM was the dependent variables.

In the individual student-level model (level 1), we controlled for such student background characteristics as gender, race and ethnicity, major field, and class level, student SES, time spent on schoolwork per week, and educational aspirations. When GAINSUM was the dependent variable, EFFORTSUM was treated as the independent variable and was grand-mean centered. As mentioned earlier, all the student-level variables were centered around the grand mean for the sample, which allowed us to interpret the intercept as the mean outcome for each institution, adjusted for student characteristics in each institution (Bryk & Raudenbush, 1992).

In the institution-level model (level 2), two sets of variables were analyzed. The first set was the five types of four-year colleges and universities -- RUs, DUs, CCUs, SLAs, and GLAs (The Carnegie Foundation for the Advancement of Teaching, 1994). The second set of variables was composed of three aggregate measures of the environment mentioned earlier: scholarly and intellectual emphasis, vocational and practical emphasis, and quality of personal relations (Kuh, et al., 1997). In addition, institutional selectivity and institutional control were also included when estimating how well the two sets of institutional characteristics predicted learning productivity.

Results

Descriptive Statistics

Table 2 presents descriptive statistics for both the student and institutional levels by institutional type. Because we used the grand mean-centered strategy for continuous variables, anything above zero on mean values indicates an above-average score. Table 2 shows that EFFORTSUM and GAINSUM at SLAs and EFFORTSUM at GLAs were above average and below average at RUs, DUs, and CCUs. These results are consistent with those reported by Kuh and Hu (in press a). Students at SLAs reported the greatest gains in general education and intellectual development, GLA students the greatest gains in personal development and vocational preparation, and RU students the greatest gains in science and technology.

In addition, students at RUs, DUs, and CCUs reported that their schools emphasized scholarly and intellectual activities less than did students at SLAs and GLAs. Students at RUs and DUs also reported lower levels overall of the quality of personal relations among various groups compared with students at the other three institutional types. Finally, RUs, DUs, and SLAs placed less emphasis on vocational and practical matters in courses compared with GLAs and CCUs.

The Unconditional Hierarchical Models

The reliability measures (lambda) in Table 3 indicate that the estimates of EFFORTSUM and GAINSUM in the model are reliable. To evaluate the effects of institutional characteristics we must partition the total variability in the dependent variable into its within-institution and between-institution components. When EFFORTSUM is the dependent variable, the within-institution variance was estimated as 0.917 and the between-institution variance as 0.085, resulting in an intraclass correlation of 8.5%. When GAINSUM was the dependent variable, the within-institution variance was estimated as 0.941 and the between-institution as 0.073. Thus, the intraclass correlation was 7.3%. These small intraclass correlations indicate that relatively little variance in either EFFORTSUM (8.5%) or GAINSUM (7.3%) is due to institutional characteristics (Table 3). The intraclass correlations when the five gain factors were dependent variables ranged from 3.3% (personal development) to 9.4% (general education), suggesting that relatively little variance in gains is a function of institutional characteristics.

(Insert Table 3 About Here)

The Within-Institution Models

To test the within-institution (random coefficient) model, the dependent variables were regressed with student-level variables and the coefficients of level 1 variables were specified as random in the level 2 models. Because this study seeks to estimate the effect of institution-level variables on student learning, the influence of student-level variables is only briefly summarized. The results from the random coefficient model indicated that EFFORTSUM, GAINSUM, and the gain factors differed by student characteristics such as gender, race or ethnicity, class level, and major field, consistent with other studies using student as the unit of analysis in conventional regression analyses (Kuh & Hu, in press b). However, although most of the variance in EFFORTSUM (91.5%) was associated with student-level characteristics, these characteristics accounted for less than 7% for EFFORTSUM. This suggested that student EFFORTSUM rarely depends on who the students are but what students really do in college. Student background characteristics and EFFORTSUM explained about 37% for GAINSUM of the total variance at student level. The variance in gains associated with student characteristics and EFFORTSUM ranged from 12.3% (vocational preparation) to 32.0% (science and technology). The EFFORTSUM coefficient was 0.555 when GAINSUM was the dependent variable in the within-institution hierarchical model, suggesting that EFFORTSUM and GAINSUM were highly related, as one would expect from the previous research (Astin, 1993; Pace, 1990; Pascarella & Terenzini, 1991). The EFFORTSUM coefficients ranged from 0.276 (vocational preparation) to .474 (personal development) when the five gain factors were the dependent variables.

The Full Models

The results from the full HLM are presented in Table 4. The two level models in the full HLM model were estimated simultaneously. Institutional sector, selectivity, institutional type, and institutional environment measures were included in the level 2 model, while all variables concerning student characteristics were included in the level 1 model. The gross effects models represent the effects of different institutional characteristics on student learning. The net effect models provide insight into how these effects are produced.

(Insert Table 4 About Here)

EFFORTSUM as Dependent Variable. When institutional sector, selectivity, institutional type, and the environment measures were examined at the institutional level, public colleges and universities had a significantly lower EFFORTSUM mean than private institutions. EFFORTSUM at RUs, and DUs did not differ from CCUs, but the SLA and GLA means were significantly higher than the CCU mean. Emphasizing scholarly and intellectual activities did not significantly contribute to EFFORTSUM, though high quality personal relations positively affected EFFORTSUM, while emphasizing vocational preparation and practical matters had a negative effect.

GAINSUM as Dependent Variable. At the institutional level, selectivity had a negative net effect on GAINSUM. After EFFORTSUM was controlled, SLAs had lower GAINSUM mean than CCUs, but GAINSUM at other types of institutions did not differ significantly from CCUs. Institutions that emphasized scholarly and intellectual activities and practical and vocational activities had positive net effects on GAINSUM, while environments that emphasized personal relationships had a negative net effect on GAINSUM. At the same time, the EFFORTSUM to GAINSUM conversion rate (the slope of EFFORTSUM) did not vary significantly with respect to institutional sector, selectivity, institutional type and institutional environment.

The gross effects of institutional characteristics on student GAINSUM are reported in the bottom panel in Table 4. It is noteworthy that there were no significant net effects of institutional characteristics on the EFFORTSUM to GAINSUM conversion rate, which makes the different directions of institutional net effects on EFFORTSUM and GAINSUM worth examining more closely. Of particular importance is the comparison between SLAs and CCUs, where the a higher level net effect on EFFORTSUM and a lower level net effect on GAINSUM does not result in any differences in gross effect at SLAs and CCUs after controlling for the institutional environment measures. This suggests that the slight gross effect advantage of SLAs over CCUs on GAINSUM in the "institutional type model" was due to the institutional environments of SLAs, as indicated in Table 2. Also, there were no significant differences in the gross effect of environments that emphasized the quality of personal relations and vocational matters on GAINSUM. However, institutional environments that emphasized scholarly and intellectual activities had both net and gross positive effects on GAINSUM.

General Education as Dependent Variable. After controlling for EFFORTSUM, institutional type had no net effect on general education gains at the institutional level. Institutions that emphasized scholarly and intellectual activities had positive net effects on general education gains, while environments that emphasized personal relationships had a slight negative net effect on general education gain. The EFFORTSUM to GAINSUM conversion rate (the slope of EFFORTSUM) was significantly higher for SLAs than in CCUs, suggesting that equal amounts of EFFORTSUM were converted to greater gains in general education for students at SLAs compared with their counterparts at CCUs. Institutions that emphasized scholarly and intellectual activities also had a slightly higher conversion rate from EFFORTSUM to general education gains.

The gross effects of institutional characteristics on general education gains are reported in the bottom panel in Table 4. Here again, institutional environments emphasizing scholarly and intellectual activities had significant gross positive effects on general education gains. Also, students at SLAs and GLAs had a slight advantage in general education gains compared with students attending CCUs.

Personal Development as Dependent Variable. At the institutional level, SLAs had a slightly smaller net effect on personal development gains (compared with CCUs), after taking into account EFFORTSUM. Institutions that emphasized practical and vocational matters had positive net effects on personal development. Neither institutional type nor environment affected the EFFORTSUM to GAINSUM conversion rate. However, selectivity had a slight negative effect on the conversion rate.

The bottom panel in Table 4 shows the gross effects of institutional characteristics on personal development gains. As one might expect, institutional environments that emphasized personal relations had significant gross positive effects on personal development gains, as did emphasizing vocational and practical matters in courses.

Science and Technology as Dependent Variable. At the institutional level, public institutions had slight net advantage over private institutions on student gains in science and technology. DUs and SLAs had smaller net effects on science and technology gains compared with CCUs, after controlling for EFFORTSUM. Institutions emphasizing scholarly and intellectual activities had positive net effects on science and technology gains and environments emphasizing personal relationships had a slight negative net effect. Institutions that emphasized scholarly and intellectual activities also had a slightly higher conversion rate from EFFORTSUM to science and technology gains. Emphasizing scholarly and intellectual activities had significant gross positive effects on science and technology gains (Table 4, bottom panel). Also, DUs and SLAs had smaller gross effects on science and technology gain in comparison to CCUs.

Vocational Preparation as Dependent Variable. At the institutional level, institutions that emphasized vocational and practical matters had positive net effects on vocational preparation gains and a slightly larger slope of EFFORTSUM. However, institutions with high quality personal relations had a slight negative net effect on vocational preparation. Emphasizing vocational and practical matters also had significant gross positive effects on vocational preparation gains. Public institutions had a slightly smaller gross effect on vocational preparation than private institutions.

Intellectual Development as Dependent Variable. Holding EFFORTSUM constant, selectivity had a negative effect on intellectual development gains. SLAs had a smaller net effect on intellectual development gains compared with CCUs. Institutions that emphasized scholarly and intellectual activities had positive net effects on intellectual development gains, while environments that emphasized personal relationships had a slight negative net effect. Institutional characteristics had no effect on the EFFORTSUM to GAINSUM conversion rate. While institutional selectivity was negatively related to the gross effects of institutional characteristics on intellectual development gains, emphasizing scholarly and intellectual activities had significant gross positive effects.

Institutional type and institutional environment are usually correlated to some extent (Table 2). Therefore, in order to help understand the relationships between institutional type or environment and learning productivity, we reported the results from the institutional type and institutional environment models in Appendix B and C. However, since the focus of this study is to examine the effects of institutional characteristics on student learning productivity, we did not report the results in Appendix B and C in detail.

Limitations

This study is limited in that the data are from those institutions that voluntarily administered the CSEQ. If data from other institutions were included the findings might change in unknown ways. The sampling and administration procedures likely vary across institutions, and are other potential sources of bias with unknown effects. It's also possible that the results would change if additional student-level measures (e.g., ability, motivation) and institution-level data (e.g., resources) were included in the model. That said, the CSEQ research program represents one of the most extensive national databases with survey information from college students related to their quality of effort and gains from college. It is one of the few available sources of information from multiple institutions about the undergraduate experience that can be used to examine the influence of institutional characteristics on learning productivity.

Discussion

With these limitations in mind, three major findings from this study stand out. First, the largest portion of variance in the EFFORTSUM and GAINSUM learning productivity indicators was related to individual level variables; yet individual student characteristics explained only a small portion of the total variance in EFFORTSUM. Perhaps this was partly due to the absence of measures of individual student motivation or other important individual variables in the model. However, this also suggested what the students do in college has very little to do with what the students are in the conventional measures. That suggested the students can make their own efforts to make most out of colleges.

Second, only a small (though significant) portion of the variance in EFFORTSUM (8%) and GAINSUM (7%) could be attributed to institutional characteristics. However, institutional type and institutional environment measures accounted for a large portion of variance in EFFORTSUM between institutions, 39% and 44% respectively when they were included in modeling separately. Though the institutional environment explained a substantial amount of variance in GAINSUM between institutions (30.7%), it accounted for only a trivial portion of variance in the slope of EFFORTSUM to GAINSUM. Consistent with previous research, institutional type as defined by the 1994 Carnegie scheme did not effectively account for much variance on GAINSUM or the slope (conversion rate) of EFFORTSUM to GAINSUM.

Finally, the examination of the gross effects and the net effects of institutional characteristics (sector, selectivity, type, environment) on EFFORTSUM and GAINSUM suggests that some institutional characteristics may have a net positive effect on EFFORTSUM but a net negative effect on GAINSUM, which may lead to no gross effect on GAINSUM. The converse also seems to be possible in that institutional characteristics have a net negative effect on EFFORTSUM but a net positive effect on GAINSUM. For example, an institutional environment emphasizing personal relations positively affects EFFORTSUM at the institutional level (which in turn has a significant positive effect on GAINSUM), but it had a negative net effect on GAINSUM and, therefore, no gross effect on institutional average GAINSUM. However, an environment emphasizing vocational and practical matters had a negative effect on EFFORTSUM but a positive net effect on GAINSUM with no gross effect on GAINSUM. The only institutional characteristic that had a positive net effect on EFFORTSUM, a net positive effect on GAINSUM, and a gross positive effect on GAINSUM was an institutional environment that emphasized scholarly and intellectual activities, as indicated in the institutional environment model.

Because institutions have different missions and educational goals we can expect that these different foci and curricular emphases will have differential effects on student gains (Pace, 1990b). This is evident in some of the findings from this study where institutional environments that emphasized scholarly and intellectual activities had gross positive effects on GAINSUM, general education, science and technology, and intellectual development, and where environments that emphasized personal relations had gross positive effects on EFFORTSUM and personal development. Interestingly, although institutional environment emphasizing vocational and practical matters had negative effects on EFFORTSUM, such environments had positive gross effects on personal development and vocational preparation. This seems to support Freeland's (1999) endorsement of a "practice-oriented" approach to undergraduate education that will help students cultivate the skills needed to succeed vocational and socially after college.

Some of these findings are seemingly at odds with what we reported previously (Kuh & Hu, in press b) when the student was the unit of analysis and student perceptions of institutional environments were treated as independent variables. The findings from our earlier study showed that individual student perceptions positively affected effort and gains at all institutions. More specifically, perceptions of all three dimensions of institutional environments had positive net effects on GAINSUM and all five gain factors and environments emphasizing scholarly and intellectual activities and vocational and practical matters had positive effects on EFFORTSUM. The seemingly contradictory results from the two studies may be a function of within- and between-institution effects, especially when most of the variance is a function of individual students and only a small amount of the variance can be attributed to institutional characteristics. Ignoring the multilevel character of the data may produce what appear to be different results. For example, the between-institution comparisons in the current multilevel study showed that aggregated perceptions of institutional environments do have different effects on institution-level student average efforts and average gains. Even though institutions that emphasize vocational and practical matters may positively affect individual student engagement in educational purposeful activities, institutions that place a great emphasis on vocational and practical matters may still have lower institution-wide average levels of engagement. At the same time, while environments emphasizing vocational and practical matters may have a lower level of institution-wide average engagement, institutions that emphasize vocational and practical matters may benefit students in terms of vocational preparation and personal development.

Pascarella and Terenzini (1991) explained that the results from different methods often have different implications. The findings from this study are a good example of their observation and underscore the need to use multi-level model when analyzing data from multiple institutions. Without considering the nature of nested data structure from multiple institutions (where students are nested within institutions), the conclusions from the conventional regression analysis could be misleading. Hence, analytical models such as HLM have more direct links to the conversation about institutional quality in promoting student learning than the conventional regression analysis.

Conclusions

The findings from this study point to three conclusions. First, the learning productivity model described here clearly distinguished among three paths of institutional influence on student learning productivity: (a) what students do in college reflected by the institutional net effect on EFFORTSUM, (b) institution-wide average student gain represented by the institutional net effect on GAINSUM, and (c) the degree to which student effort is converted into gains, which is reflected by the institutional net effect on the EFFORTSUM-GAINSUM conversion rate. This conclusion has implications for the national conversation about collegiate quality in that efforts to improve the quality of undergraduate education should consider ways to promote student learning through all three routes. Schools that leverage their resources and those of their students in this regard would improve their learning productivity, thus benefiting students in terms of greater levels of learning and personal development. Colleges and universities can enhance student learning by discovering more about how each contributes to desired outcomes and focusing institutional effort on improving the impact of each on gains.

Second, when different gain outcomes were considered, institutional characteristics have varied effects on institutional level average gains and the conversion rates from effort to gains. That is, certain institutional characteristics may well contribute to certain types of student learning but become constraints on students in other types of learning. For instance, although institutional emphasis on vocational and practical matters can not help involve students in college activities, it has positive gross effect on student vocational preparations. Institutions often have different missions and educational goals; therefore, the conversations about institutional quality need to consider the mission differentiation of American colleges and universities.

Finally, institutional environments have a greater effect on learning productivity than the other institutional characteristics examined in this study. This means that we need to learn more about role of institutional environments in fostering student quality of effort in college activities, in enhancing the average gains from college and improving the conversion rate of effort to gains, which is key to learning efficiency. We also need more sensitive and sophisticated measures of various aspects of institutional environments that appear to have differential effects on student outcomes (Astin, 1993b). The fourth edition of the CSEQ includes some additional measures about institutional diversity and computing and information technology that may affect the relationship of effort to gains and the conversion rate. Institutions should also examine the ways in which various dimensions of their environments promote or hinder student learning and take steps to develop these positive learning-centered attributes and minimize those dimensions that inhibit student learning. For example, does communicating high expectations by faculty members and others have an effect on student perceptions of a scholarly and critical environment? Or is the peer culture and the perceptual environment created by being in the presence of other highly motivated, high ability students a factor? Even though selectivity was controlled, perhaps other factors are at work that affect these views.

Implications For Research

We agree with Johnstone: "we need to focus more on the student and his or her learning, and to be a little less preoccupied with, and critical of, the faculty (and all of the rest of the administrative, professional, and clerical support staff of our colleges and universities) in our quest for more productivity" (1993, p. 4). In addition to the persistent search for more resources and increasing selectivity, we need to learn more about how these factors and others influence the nature and amount of effort students devote to educational purposeful activities and how students use school resources into their learning. Additional institutional characteristics should be taken into account in such models, such as size, allocations of resources (e.g., undergraduate instruction, graduate student support, student support services, and overall educational expenditures) to determine the institutional effects on student learning productivity. The results of this study clearly show that it is the institutional environment, not the type of institution under the current Carnegie classification, that is most important in determining how much students learn.

Because the gross Carnegie Foundation institutional categories fail to illuminate some important aspects of the undergraduate experience, this study may also have implications for more effectively classifying institutions that include undergraduate education in their mission. One approach is to determine how well schools are functioning in each of the three dimensions of learning productivity. Some schools may do better than others and such patterns may be distinctive enough to warrant creating an alternative institutional typology. A new classification schema based on learning productivity indicators would be an improvement over the 1994 Carnegie Classification of Institutions of Higher Education. Ironically, this schema has had the opposite effect of what was originally intended, which was to dampen trends toward homogenization and preserve or possible increase institutional diversity (Carnegie, 2000). Instead, it has had an almost pernicious effect by inducing schools to emulate those perceived to be more prestigious, such as the research university, a phenomenon Jencks and Riesman labeled "a snake-life procession." This mission creep has had deleterious effects on goal setting, reward structures, and many other operational aspects of institutions of higher education that directly affect the amount of institutional effort directed toward undergraduate education. A logical extension of the learning productivity model could be an institutional typology that effectively differentiates colleges and universities by taking into account these three strands of institutional contributions to different types of student learning. Additional efforts are need to discover if other institutional dimensions not accounted for in the Carnegie Classification more effectively differentiate institutions in terms of student learning.

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TABLE 1.
Sample Means, Standard Deviations, and Variable Description on Original Variables

VARIABLE	Mean (%)	S.D.	Description
Student-level variables (N=44,238)			
Men	39.0%		A dummy variable (Yes=1, No=0)
Women	61.0%		Reference group
American Indian and Other	3.0%		A dummy variable (Yes=1, No=0)
Asian or Pacific Islander	7.0%		A dummy variable (Yes=1, No=0)
African American	6.0%		A dummy variable (Yes=1, No=0)
Hispanic	3.0%		A dummy variable (Yes=1, No=0)
White	81.0%		Reference group
SES	4.76	1.66	Sum of measures of who pays for college and parents' education, ranging from 2 to 7
Academic Preparation	6.88	1.40	Sum of college grades and educational aspirations, ranging from 2 to 11
Time on Schoolwork	2.85	1.06	Hours per week on academic work, ranging from 1 (less than 20 hours) to5 (about 50 hours)
Humanities	15.0%		A dummy variable (Yes=1, No=0)
Math and sciences	24.0%		A dummy variable (Yes=1, No=0)
Social sciences	18.0%		A dummy variable (Yes=1, No=0)
Pre-professional	44.0%		Reference group
Sophomore	21.0%		A dummy variable (Yes=1, No=0)
Junior	14.0%		A dummy variable (Yes=1, No=0)
Senior	24.0%		A dummy variable (Yes=1, No=0)
First-year student	41.0%		Reference group
EFFORTSUM	278.04	45.96	Sum of student responses to quality of effort items, ranging from 128 to 512
GAINSUM	58.88	11.26	Sum of student responses to gain items, ranging from 23 to 92
General Education	14.38	3.70	Responses to general education gain item, ranging from 6 to 24
Personal Development	13.94	3.24	Responses to personal development gain items, ranging from 5 to 20
Science and Technology	6.38	2.57	Responses to science and technology gain items, ranging from 3 to 12
Vocational Preparation	7.87	2.11	Responses to vocational preparation gain items, ranging from 3 to 12
Intellectual Development	16.33	3.59	Responses to intellectual development gain items, ranging from 6 to 24

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School-level variables (N=120)

RU	17.0%		A dummy variable (Yes=1, No=0)
DU	12.0%		A dummy variable (Yes=1, No=0)
SLA	12.0%		A dummy variable (Yes=1, No=0)
GLA	25.0%		A dummy variable (Yes=1, No=0)
CCU	34.0%		Reference group
Public	44.0%		A dummy variable (Yes=1, No=0)
Private	56.0%		Reference group
Institutional selectivity	3.33	1.18	Selectivity measure from Barron, ranging from 1 to 6
Scholarly and Intellectual Environment	15.69	1.04	Scholarly and intellectual emphasis, aggregated to institutional level, ranging from 13.66 to 18.75
Personal Relations Environment	15.33	0.95	Emphasis on quality of personal relations, aggregated to institutional level, ranging from 12.64 to 18.36
Vocational and Practical Environment	9.60	0.67	Vocational and practical emphasis, aggregated to institutional level, ranging from 6.76 to 11.71

NOTES: In this table, descriptive statistics were reported from the raw data. In the following tables, continuous variables at student level were standardized as Z-score (M=0, SD=1), centered around the grand-mean of the sample of students; continuous variables at institutional level were standardized as Z-score (M=0, SD=1), centered around the grand-mean of the sample of institutions.

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TABLE 2.
Unadjusted Descriptive Statistics on Student and Institutional Variables By Institutional Type

VARIABLE	RU		DU		CCU		SLA		GLA	
Student-level										
Men	43.7%		34.6%		37.0%		35.2%		36.7%	
Women	56.3%		65.4%		63.0%		64.8%		63.3%	
American Indian and Other	3.4%		1.5%		3.3%		3.0%		1.6%	
Asian or Pacific Islander	16.5%		2.7%		2.2%		5.0%		1.5%	
African American	5.2%		6.0%		8.1%		2.1%		5.0%	
Hispanic	3.4%		2.0%		2.6%		1.6%		1.5%	
White	71.5%		87.8%		83.8%		88.3%		90.4%	
SES	0.27	(0.95)	0.10	(1.01)	-0.28	(0.98)	0.34	(0.92)	-0.25	(0.94)
Academic Preparation	0.01	(1.00)	-0.03	(0.95)	0.05	(1.02)	-0.07	(0.92)	0.03	(1.03)
Time on Schoolwork	-0.11	(1.00)	-0.02	(0.94)	0.20	(1.00)	-0.35	(0.94)	-0.05	(0.99)
Humanities	13.9%		13.8%		12.2%		27.1%		16.2%	
Math and sciences	33.1%		18.2%		17.5%		28.8%		19.0%	
Social sciences	17.4%		16.6%		15.5%		24.9%		18.2%	
Pre-professional	35.6%		51.5%		54.8%		19.2%		46.7%	
Sophomore	22.3%		29.2%		19.0%		19.8%		15.3%	
Junior	12.8%		17.7%		12.1%		16.0%		14.7%	
Senior	8.8%		14.5%		33.9%		16.5%		26.3%	
First-year student	46.1%		38.7%		35.0%		47.8%		43.7%	
EFFORTSUM	-0.05	(0.96)	-0.02	(0.98)	-0.11	(1.02)	0.36	(0.94)	0.14	(1.02)
GAINSUM	-0.05	(0.99)	-0.01	(0.98)	-0.04	(1.01)	0.18	(0.98)	0.01	(1.00)
General Education	-0.07	(1.00)	-0.02	(0.97)	-0.07	(0.98)	0.42	(1.00)	0.05	(0.99)
Personal Development	-0.07	(1.01)	0.04	(0.99)	0.00	(1.01)	0.02	(0.95)	0.09	(0.99)
Science and Technology	0.08	(1.03)	-0.10	(0.94)	-0.04	(0.97)	0.03	(1.03)	-0.04	(1.01)
Vocational Preparation	-0.05	(1.01)	0.00	(1.00)	0.02	(1.01)	-0.10	(0.92)	0.13	(0.98)
Intellectual Development	-0.03	(1.01)	0.01	(1.00)	-0.02	(0.99)	0.14	(1.00)	0.02	(0.98)
Institution-level										
Public	65.0%		71.4%		63.4%		0.0%		13.3%	
Private	35.0%		28.6%		36.6%		100.0%		86.7%	
Institutional selectivity	0.92	(1.05)	0.33	(1.27)	-0.40	(0.56)	0.80	(0.88)	-0.62	(0.53)
Scholarly and Intellectual	-0.39	(0.98)	-0.26	(0.86)	-0.34	(0.70)	0.59	(0.82)	0.12	(0.88)
Personal Relations	-0.99	(0.83)	-0.60	(0.51)	0.01	(1.08)	0.59	(0.62)	0.63	(0.54)
Vocational and Practical	-0.62	(1.17)	-0.31	(0.60)	0.27	(0.72)	-0.73	(1.43)	0.55	(0.59)

TABLE 3.
Psychometric Properties from HLM Models

PSYCHOMETRIC PROPERTY	EFFORTSUM	GAINSUM	General Education	Personal Development	Science and Technology	Vocational Preparation	Intellectual Development
Within-Institution variance (sigma squared)	0.917	0.941	0.915	0.971	0.953	0.935	0.947
Between-Institution variance (tau)	0.085	0.074	0.095	0.033	0.060	0.077	0.069
Between-Institution standard deviation	0.291	0.272	0.309	0.181	0.245	0.277	0.263
Reliability (lambda)	0.934	0.924	0.941	0.848	0.909	0.927	0.919
Intraclass correlation	0.085	0.073	0.094	0.033	0.059	0.076	0.068

NOTES: The intraclass correlation indicates the proportion of total variances in the outcome variables lies between institutions. It was computed as follows: intraclass correlation = tau / (tau + sigma squared).

TABLE 4.
Results from HLM Models: The Full Model

	EFFORTSUM		GAINSUM		General Education		Personal Development		Science and Technology		Vocational Preparation		Intellectual Development	
	Beta	Sig.	Beta	Sig.	Beta	Sig.	Beta	Sig.	Beta	Sig.	Beta	Sig.	Beta	Sig.
Net Effect														
Institution mean														
Public	-0.098	*	0.048		0.055		0.047		0.060	~	-0.038		0.049	
Selectivity	0.006		-0.033	*	-0.016		0.003		-0.019		-0.014		-0.062	***
RU	0.011		0.014		-0.052		0.004		-0.006		0.049		0.060	
DU	0.048		-0.022		-0.039		0.014		-0.107	**	0.004		0.022	
SLA	0.115	~	-0.074	*	0.042		-0.064	~	-0.125	***	-0.026		-0.114	*
GLA	0.114	*	-0.027		0.015		-0.019		-0.047		-0.004		-0.046	
Scholarly and Intellectual	0.034		0.087	***	0.101	***	-0.003		0.070	***	-0.018		0.137	***
Personal Relations	0.070	*	-0.038	**	-0.046	~	0.006		-0.048	~	0.007		-0.049	*
Vocational and Practical	-0.038	*	0.024	*	-0.014		0.051	***	0.002		0.092	***	-0.012	
Slope of EFFORTSUM														
Intercept			0.563	***	0.453	***	0.466	***	0.331	***	0.264	***	0.432	***
Public			-0.002		0.002		0.001		-0.009		0.001		-0.007	
Selectivity			0.003		-0.003		-0.015	~	0.004		0.003		0.012	
RU			0.016		0.026		0.016		0.004		0.010		0.009	
DU			0.010		0.014		0.025		0.001		0.007		0.012	
SLA			0.029		0.038	*	0.014		-0.017		0.024		0.037	
GLA			0.005		0.002		0.005		-0.013		0.030		0.009	
Scholarly and Intellectual			0.010		0.016	~	-0.001		0.015	~	0.011		0.002	
Personal Relations			-0.007		-0.007		-0.002		-0.013		-0.017	~	-0.002	
Vocational and Practical			0.004		0.005		-0.008		0.005		0.017	~	0.002	
Gross Effect														
Institution mean														
Public	-0.098	*	-0.009		0.009		-0.005		0.025		-0.069	~	0.003	
Selectivity	0.006		-0.024		-0.012		0.012		-0.016		-0.011		-0.056	**
RU	0.011		0.012		-0.050		0.004		-0.005		0.049		0.060	
DU	0.048		-0.003		-0.021		0.029		-0.091	*	0.013		0.038	
SLA	0.115	~	-0.010		0.104	~	-0.020		-0.091	*	0.006		-0.056	
GLA	0.114	*	0.033		0.068	~	0.029		-0.012		0.028		0.002	
Scholarly and Intellectual	0.034		0.105	***	0.118	***	0.010		0.081	***	-0.008		0.150	***
Personal Relations	0.070	*	0.001		-0.015		0.044	*	-0.026		0.023		-0.017	
Vocational and Practical	-0.038	*	0.002		-0.034		0.034	*	-0.012		0.083	***	-0.031	

NOTES: ~ p < 0.1, * p < .05, ** p < .01, and *** p < .001.

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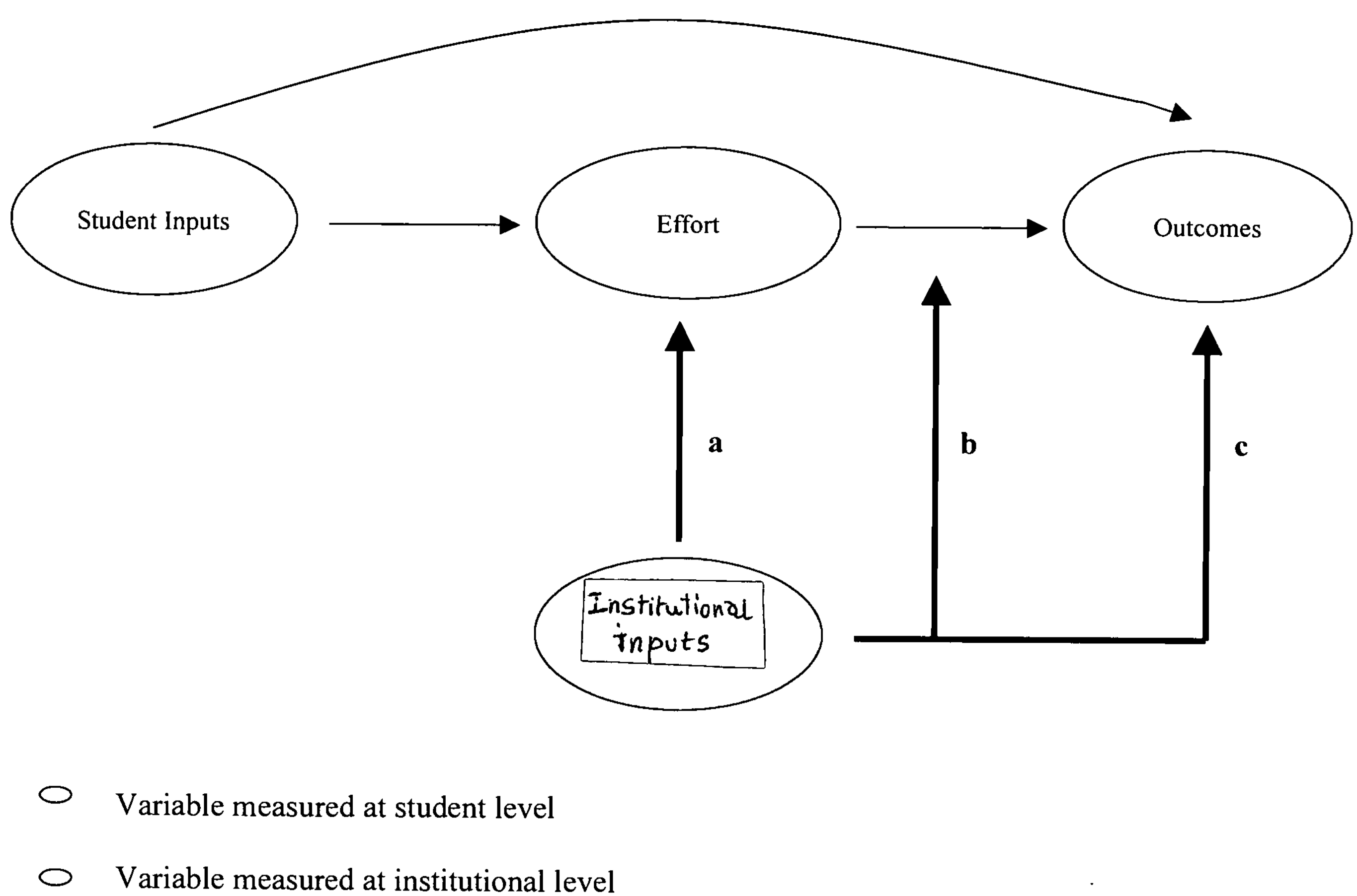
FIGURE 1.
The Learning Productivity Model



APPENDIX A
CSEQ (3rd Ed.) Scales and Items

ACTIVITIES SCALES

- Library (10 items)
- Experience with Faculty (10 items)
- Course Learning (10 items)
- Art, Music, Theater (12 items)
- Student Union (10 items)
- Athletic and Recreation (10 items)
- Clubs and Organizations (10 items)
- Experience in Writing (10 items)
- Personal Experiences (8 items)
- Student Acquaintances (10 items)
- Science (10 items)
- Campus Residence (10 items)
- Topics of Conversation (10 items)
- Information in Conversations (6 items)

ENVIRONMENT ITEMS

1. *Scholarly and Intellectual*
- Academic, scholarly, and intellectual qualities
- Aesthetic, expressive, and creative qualities
- Critical, evaluative, and analytical qualities

2. *Personal Relations*
- Relations among students and student groups
- Relations with faculty members
- Relations with administrative personnel and offices

3. *Practical and Vocational*
- Vocational and occupational competence
- Personal relevance and practical value of courses

GAINS ITEMS

1. *General Education*
- Understanding and enjoyment of art, music, drama
- Acquaintance with and enjoyment of literature
- Knowledge of history
- Knowledge about different parts of the world and people
- Awareness of different philosophies, cultures, ways of life
- Broad general education

2. *Personal Development*

- Values and ethical standards
- Self-understanding
- Ability to get along with others
- Teamwork skills
- Good health habits and physical fitness

3. *Science and Technology*

- Science and experimentation
- Science and technology developments
- Consequences of science and technology

4. *Vocational Preparation*

- Job or work skills
- Background for further education
- Career information

5. *Intellectual Development*

- Writing
- Computers and other information technologies
- Analytical and logical thinking
- Quantitative problem solving
- Synthesis ability
- Self-directed learning

Appendix B.
Results from HLM Models: Institutional Type Model

	EFFORTSUM		GAINSUM		General Education		Personal Development		Science and Technology		Vocational Preparation		Intellectual Development	
	Beta	Sig.	Beta	Sig.	Beta	Sig.	Beta	Sig.	Beta	Sig.	Beta	Sig.	Beta	Sig.
Net Effect														
Institution mean														
Public	-0.154	***	0.031		0.012		0.012		0.072	*	-0.089	*	0.040	
Selectivity	0.032		-0.004		0.035		-0.020		0.012		-0.065	**	0.004	
RU	-0.060		-0.013		-0.067		-0.015		-0.005		0.029		0.024	
DU	0.017		-0.028		-0.032		-0.002		-0.097		-0.018		0.022	
SLA	0.190	**	-0.013		0.152	**	-0.114	***	-0.059		-0.120	*	0.029	
GLA	0.140	**	-0.010		0.041		-0.025		-0.033		-0.018		-0.010	
Slope of EFFORTSUM														
Intercept			0.562	***	0.454	***	0.461	***	0.328	***	0.262	***	0.432	***
Public			-0.003		-0.002		0.007		-0.008		0.003		-0.007	
Selectivity			0.005		0.002		-0.014	*	0.009		0.002		0.012	
RU			0.016		0.021		0.022		0.005		0.017		0.010	
DU			0.010		0.013		0.028		0.005		0.011		0.013	
SLA			0.035	*	0.050	**	0.019		-0.007		0.023		0.038	~
GLA			0.009		0.007		0.005		-0.009		0.026		0.012	
Gross Effect														
Institution mean														
Public	-0.154	***	-0.054		-0.009		-0.068	~	0.021		-0.134	***	-0.026	
Selectivity	0.032		0.018		0.053	*	-0.004		0.025		-0.055	**	0.021	
RU	-0.060		-0.052		-0.097	~	-0.050		-0.027		0.011		-0.004	
DU	0.017		-0.024		-0.027		-0.003		-0.090	*	-0.017		0.026	
SLA	0.190	**	0.095	~	0.250	***	-0.037		-0.001		-0.069		0.122	~
GLA	0.140	**	0.065		0.106	*	0.036		0.010		0.021		0.049	

NOTES: ~ $p < 0.1$, * $p < .05$, ** $p < .01$, and *** $p < .001$.

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Appendix C.
Results from HLM Models: Institutional Environment Model

	EFFORTSUM		GAINSUM		General Education		Personal Development		Science and Technology		Vocational Preparation		Intellectual Development	
	Beta	Sig.	Beta	Sig.	Beta	Sig.	Beta	Sig.	Beta	Sig.	Beta	Sig.	Beta	Sig.
Net Effect														
Institution mean														
Public	-0.144	**	0.063	*	0.041		0.061	*	0.079	*	-0.032		0.080	*
Selectivity	-0.013		-0.023		-0.033		0.011		-0.013		-0.003		-0.037	*
Scholarly and Intellectual	0.050	~	0.075	***	0.112	***	-0.013		0.052	*	-0.025		0.116	***
Personal Relations	0.072	*	-0.041	**	-0.038		0.005		-0.047	~	-0.000		-0.059	**
Vocational and Practical	-0.047	*	0.032	*	-0.021		0.058	***	0.012		0.097	***	0.001	
Slope of EFFORTSUM														
Intercept			0.556	***	0.465	***	0.474	***	0.328	***	0.262	***	0.432	***
Public			-0.005		0.001		-0.000		-0.003		-0.011		-0.013	
Selectivity			0.004		0.001		-0.012	~	0.007		-0.001		0.011	
Scholarly and Intellectual			0.013		0.028	*	-0.001		0.013	~	0.013		0.000	
Personal Relations			-0.010		-0.011		-0.005		-0.015		-0.017	~	-0.003	
Vocational and Practical			0.002		0.003		-0.007		0.006		0.009	~	-0.001	
Gross Effect														
Institution mean														
Public	-0.144	**	-0.020		-0.029		-0.012		0.029		-0.077	*	0.013	
Selectivity	-0.013		-0.027	~	-0.039	~	0.009		-0.017		-0.005		-0.040	*
Scholarly and Intellectual	0.050	~	0.102	***	0.138	***	0.006		0.068	***	-0.012		0.137	***
Personal Relations	0.072	*	0.001		-0.005		0.043	*	-0.024		0.018		-0.026	
Vocational and Practical	-0.047	*	0.004		-0.045	*	0.037	*	-0.004		0.085	***	-0.023	

NOTES: ~ $p < 0.1$, * $p < .05$, ** $p < .01$, and *** $p < .001$.

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